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SHORT COMMUNICATION

Natural prey of the crab spider *Xysticus marmoratus* (Araneae: Thomisidae) on *Eryngium* plants

Elchin Fizuli oglu Huseynov: Institute of Zoology, National Academy of Sciences, block 504, passage 1128, Baku 370073, Azerbaijan. E-mail: hun-vey-bin@rambler.ru

Abstract. The natural prey of medium-sized juvenile (ca. 3 mm) crab spiders *Xysticus marmoratus* Thorell 1875 inhabiting *Eryngium biebersteinianum* plants was studied on the Absheron Peninsula, Azerbaijan. The percentage of specimens found feeding on prey was low (3.4%). *Xysticus marmoratus* is a polyphagous predator with representatives of four arthropod orders found in its diet. The primary food of *X. marmoratus* was ants (Formicidae), which accounted for 83.3% of the total number of prey. The length of prey killed by *X. marmoratus* ranged between 0.87–7.50 mm (mean 2.96 mm) and constituted from 28.5–300.0% (mean 96.9%) of the length of their captors. The most frequently captured size group of prey was 50–70% the length of the spiders.

Keywords: Flower-dwelling, diet, myrmecophagy, prey length

With over 2000 described species, Thomisidae is one of the largest families of spiders (Platnick 2013). However, despite the family members' great diversity and potential predatory significance, few studies have addressed the natural prey of thomisids. A survey of arachnological literature revealed that quantitative data on the natural diet are available for only fifteen species of crab spiders (Broekhuysen 1948; Nyffeler & Benz 1979; Tarabaev 1979; Morse 1981, 1983; Ricek 1982; Lubin 1983; Dean et al. 1987; Agnew & Smith 1989; Castanho & Oliveira 1997; Schmalhofer 2001; Romero & Vasconcellos-Neto 2003; Guseinov 2006; Huseynov 2007 a, b). Crab spiders (Thomisidae) do not use silk for prey capture; instead, they lie in ambush and wait until prey comes within reach of their long raptorial forelegs (Foelix 1996).

Xysticus marmoratus Thorell 1875 has not previously been the subject of ecological or behavioral investigation. *Xysticus marmoratus* is distributed from Eastern Europe to Central Asia (Marusik & Logunov 1994). It is a small crab spider (adult body length 4–6 mm), with adult males usually slightly smaller than females. In Azerbaijan, *X. marmoratus* occurs in arid habitats, including semi-deserts and steppes. *Xysticus marmoratus* has an annual life cycle. Adult specimens are found in October and November and inhabit grass litter. In contrast, juveniles are very abundant on flowering plants throughout the summer (Huseynov unpubl. data).

This investigation was carried out on the Absheron Peninsula, Azerbaijan. The three primary study sites were located near the villages of Shagan, Gres, and Bina (40°27′30″N 50°04′08″E), where over 95% of the total observation time was spent. Additionally, two secondary study sites were located near Gala village and Ganly-Gyol Lake. The study sites were areas of ephemeral semi-desert covered with dwarf shrubs *Eryngium biebersteinianum* Nevski, *Alhagi pseudoalhagi* (MB), *Noaea mucronata* (Forsk), and several herbs and grasses. The sites near Shagan, Bina, and Ganly-Gyol were additionally characterized by planted pines, *Pinus eldaricus* Medw., while the others were treeless.

All individuals of *Xysticus* observed during the study period were immature. They were abundant only on *Eryngium biebersteinianum*; therefore, observations were concentrated exclusively on this plant. The prey of spiders was sampled during three successive years: 1997 (2 July–9 August), 1998 (14 June–25 July), and 1999 (14 June–31 July). Fifty surveys were conducted during these periods, which took about 113 hours. During the surveys, *E. biebersteinianum* plants were thoroughly searched for *Xysticus*, and the mouthparts of each individual spider found were inspected with a hand-lens of 4× magnification to avoid overlooking small prey. Spiders with prey in their chelicerae were captured with a transparent cup, placed in separate vials containing 75% ethyl alcohol and brought back to the laboratory for measurement and prey identification. Spiders without prey were left in the field. All surveys were done in the daylight hours between 11:00 and 21:00. Most of these surveys were conducted between 11:00 and 17:00. The number of prey collected from *Xysticus* increased after 18:00. Therefore, a five-day series of double surveys was undertaken in July 1999 at Bina. On each of these days, one survey was made during the first half of the day (11:00–16:00) and another during the second half of the day (18:00–21:00).

All *Xysticus* individuals observed in the field were of approximately the same size and had a similar color pattern, suggesting that they belonged to the same species. To identify the species, I collected forty living specimens from *Eryngium* in July 2006 at Bina (where 85% of all spiders were observed in 1997–1999) and reared them in the laboratory until they reached maturity. Spiders were kept separately in glass vials (50 mm long, 8 mm diameter) under a natural light-dark regime. Two types of prey were offered to these spiders. "Innocuous" prey included various specimens of Diptera, and "dangerous" prey were workers of the ant *Lasius alienus* Forster 1850. The prey insects were collected in the garden of the Institute of Zoology, Baku, and only those between 50–100% of the spiders' body length were used in the feeding experiments. Individual spiders were fed three times a week with one of the prey types in a random order. Interactions between spiders and prey were monitored for two hours, and the prey was recorded as accepted if it was captured and consumed by spider during this period. I considered the prey to be consumed by the spider if it was not released immediately and was held in the chelicerae for at least 15 minutes after capture. Thirty-five juveniles survived to adulthood in the laboratory, and all these proved to be *X. marmoratus*. Voucher specimens of *X. marmoratus* and their prey items were deposited in the Institute of Zoology of Azerbaijan Academy of Sciences.

In total, 2,495 specimens of *X. marmoratus* were observed in the field, 84 of which (3.4%) had prey in their chelicerae. One juvenile was consuming two prey items simultaneously. Thus the actual number of feeding events was 85. Individuals of *X. marmoratus* fed significantly less frequently during the first half of the day (6 prey records of 583 spider observations) than during the second half (38 of 614) (χ^2_1 = 21.1; $P < 0.001$).

One *X. marmoratus* individual dropped its prey before it could be captured, so 84 prey items were collected for dietary analysis. These were distributed among four orders of arthropods, including three from the class Insecta (Hymenoptera, Coleoptera, and Diptera) and

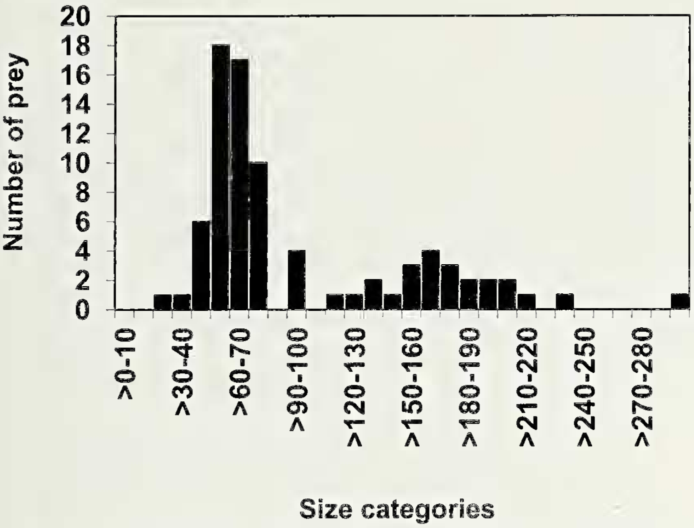

Figure 1.—Distribution of prey of *Xysticus marmoratus* in different size categories (body lengths of prey expressed as percentages of the body lengths of their captors).

one from the class Arachnida (Araneae). By far the dominant prey order was Hymenoptera, which accounted for 92.9% of total prey. Most of the Hymenoptera captured were ants (ca. 90%). They included representatives of subfamilies Formicinae [43 *Plagiolepis* sp., 8 *Cataglyphis aenescens* (Nylander 1849), 3 *Cataglyphis setipes* (Forel 1894), 1 *Stenamma* sp.)], Myrmecinae (7 *Messor denticulatus* Santschi 1927, 7 *Cardiocondyla* sp.) and Dolichoderinae (1 *Tapinoma* sp.). Except for two winged males of *M. denticulatus*, all ants were workers. Other Hymenoptera consisted of three halictid bees (*Halictus* sp., *Nomioides* sp., *Sphecodes* sp.), three stinging wasps (2 Bethylidae and 1 Thiphiidae) and two parasitic wasps (Braconidae and Scelionidae). The remaining arthropods included three adult beetles (2 Dermestidae and 1 Bruchidae), two flies (Chloropidae and Milichiidae) and a conspecific spider (juvenile *X. marmoratus*).

Of 620 ants and 442 dipterans offered to spiders in the laboratory, 542 ants (87.4%) and 397 dipterans (89.8%) were eaten by *X. marmoratus*, the rates of acceptance of these prey groups being very similar.

Eighty-one natural prey items were measured. Their lengths varied from 0.87–7.50 mm (mean ± SD: 2.96 ± 1.77 mm) and constituted from 28.5–300.0% (96.9 ± 57.5%) of the length of their captors, which ranged from 2.25–3.80 mm (3.05 ± 0.30 mm). The size distribution of the prey in relation to the sizes of their captors is shown in Fig. 1. Most of the prey did not exceed the length of their captors (70.4%, $n = 57$). These included *Plagiolepis*, *Cardiocondyla*, *Tapinoma* and *Stenamma* ants, bethylid and scelionid wasps, as well as beetles, flies, and a conspecific spider. The most frequently captured (60.5%, $n = 49$) were medium-sized arthropods from 50–100% spider body length, while small prey, not exceeding half the length of the spiders, were represented by only eight items (9.9%). About one third of the prey of *X. marmoratus* consisted of large arthropods exceeding the length of their captors. These prey consisted of *Cataglyphis* and *Messor* ants, thiphiid and braconid wasps, and halictid bees. Many of the large prey (23.5%, $n = 19$) exceeded 150% of the body length of their captors.

The percentage of *X. marmoratus* individuals found while feeding was low (< 10%), as is typical of cursorial spiders (Nyffeler & Breene 1990) and crab spiders in particular (Nyffeler & Benz 1979; Dean et al., 1987; Romero & Vasconcellos-Neto 2003; Guseinov 2006; Huseynov 2007a). The difference in prey capture rate of *X. marmoratus* at different times of the day is likely related to the fluctuation of ant activity on *Eryngium* throughout the day. In the summer, on the Absheron Peninsula, most ants are inactive during the first half of day, apparently because of high surface temperature, and start to forage only after 18:00, when the temperature decreases. In the evening large numbers of ants, especially *Plagiolepis* sp., appeared on *Eryngium*, which might result in increased prey capture by spiders.

This investigation has shown that *X. marmoratus* is a polyphagic predator feeding on a wide range of arthropods. The heavy prevalence of worker ants in its diet is unusual, since these insects possess effective defensive equipment, such as strong mandibles, a hard cuticle, poisonous stings or formic-acid spray (Blum 1981), making them unpalatable to most cursorial spiders (Nentwig 1986). Although some tropical thomisid species have been reported to feed exclusively on ants (Lubin 1983; Castanho & Oliveira 1997), such a high rate of ant capture (83.3%) has never been recorded for crab spiders from temperate regions. However, worker ants were found in lower proportions in the diets of *Xysticus cristatus* (Clerck 1757) and *Xysticus loeffleri* Roewer 1955 (Nyffeler & Benz 1979; Guseinov 2006). These data suggest that myrmecophagy is a widespread phenomenon within the genus *Xysticus*.

Does *X. marmoratus* prefer ants to other prey? Such a conclusion cannot be derived from dietary data alone. The prevalence of ants in the diet of *X. marmoratus* could be related to their abundance in its habitat. Indeed, at least in the second half of the day, ants were by far the most abundant visitors to *Eryngium*. In any case, the present field and laboratory findings unambiguously indicate that *X. marmoratus* is a quite competent ant-feeder.

Experimental studies of prey size preference in spiders have shown that while most cursorial spiders prefer prey not exceeding their own size, the crab spider *Xysticus cristatus* readily accepted insects two times larger than itself (Nentwig & Wissel 1986). Although *X. marmoratus* sometimes captured very large prey, most of its prey consisted of arthropods smaller than itself. This is in contrast with observations of two other thomisid species, *Thomisus onustus* Walckenaer 1805 and *Runcinia grammica* (C.L. Koch 1837) that also inhabit *Eryngium* plants in the same localities. Over 90% of the prey of these spiders consisted of large insects exceeding the size of their captors (Huseynov 2007 a, b). However, both of these thomisids fed primarily on non-ant prey and did not accept ants in the laboratory as readily as did *X. marmoratus* (Huseynov unpubl. data). Thus the bias toward smaller prey in the diet of *X. marmoratus* is apparently due to the prevalence of small ants in its microhabitat.

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